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Experimental Study on Properties of Concrete with Partial Replacement of Cement by Sugarcane Bagasse Ash using Manufactured Sand

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Abstract - *The creation of cement causes a natural issue by rising of carbon di oxide gas in atmosphere or air. The regular natural resources, for example, petroleum derivatives and normal asset devoured at cement production industries. To decreasing the impact on climate and condition, we can substitute the OPC by the waste material of industries. This waste result of industries, for example, bagasse ash powder can be replaced by the OPC. Since sugarcane bagasse ash powder has some concrete properties in extensive sum than cement. The silica content found in bagasse ash powder in high amount up to 65 to 82%. Bagasse is created at sugar enterprises in the wake of extricating the juice of sugarcane. At that point after bagasse is acquired in wet condition. The bagasse is first dried then utilized as a fuel in sugar businesses in the boiler to generate heat energy. The bagasse created warm vitality in the sugar industries. After the consuming of bagasse at 600 to 800-degree centigrade, the dark black ash found and this ash is called as bagasse powder. In this examination paper, we are likewise utilizing manufactured sand rather than fine aggregate or river bed sand. The manufactured sand does not have any ecological impact and it is likewise conservative in compared with riverbed sand. The river bed sand has some natural impact, for example, disintegration of waterway bed so ground dilute table can be. The cost of river bed sand is likewise high in compared with manufactured sand. Manufactured sand is created after the crushing of rock and it is found in cubical shape. The cost of concrete is substantially less expensive utilizing manufactured sand than utilizing of river bed sand. The utilizing of manufactured sand is additionally useful in light of the fact that it doesn't have any polluting influences like sediment and clay which is for the most part found in riverbed bed sand. So that the great quality of concrete can be acquired by utilizing manufactured sand. In is research paper the bagasse ash powder is partially replaced with ordinary Portland cement in the proportion of 0, 5, 10, 15, 20% by the heaviness of ordinary Portland cement in concrete with utilizing manufactured sand. Then after we conduct the test on concrete specimen of compressive strength test and split tensile strength test at 7, 14 and 28 days and flexural strength of concrete specimen at 7 and 14 days.*

Keywords: Bagasse Ash, Manufactured Sand(M-Sand), Compressive strength, Split tensile strength, Flexural tensile strength .Environmental benefits.

1.INTRODUCTION

The development exercises are expanding because of the advancement and urbanization of nations. The concrete comprise of higher quality, great toughness and different imperative variables and properties which make the concrete appropriate for construction, so requirement of cement is getting more as a construction material. The concrete expanded the requirement of ordinary Portland cement which is the primary constituent of construction material. In the creation of cement it immense measure of carbon dioxide discharges to the environment. So the rate of generation of carbon dioxide radiated to the climate is likewise expanding now a day. The sugarcane Bagasse ash is a by-item acquired from consuming of sugarcane bagasse in boilers sugar creating ventures. At the point when sugarcane wastes bagasse is burnt under the controlled way. It gives powder having expansive measure of silica, which has great pozzolanic properties. Sugarcane bagasse ash can utilized as a cement substitution material to enhance the property of concrete and decrease the cost of concrete. For every 10 tons of sugarcane smashed in a sugar industry delivers about 3 tons of wet bagasse. At the point when sugarcane bagasse consumed at temperature of 500oC to 1100oC for 5 hours to then dark fiery ash get and this slag is called as sugarcane bagasse ash. The effect of bagasse ash content as a partial substitution of cement has been researched on chemical and physical properties of solidified concrete, including compressive strength, flexural strength and split tensile strength. The fundamental structure of bagasse ash is siliceous oxide that responds with the free lime of ordinary Portland cement hydration. In any case, in bagasse ash just un-precious stone silica oxide has responsive properties. For non-crystalline slag were acquired from bagasse consuming in 700oC for an hour and a half and furthermore 800oC at time of 15 minutes. The compressive strength ,flexural strength and split tensile strength of concrete increments by expanding rate of sugarcane bagasse ash in concrete. In this research manufactured sand is utilized rather than fine aggregate or course sand or river bed sand. Manufactured sand is a substitute of river bed sand for construction purposes sand created from hard rock stone by smashing. The squashed sand is of cubical shape with grounded edges, washed and evaluated to as a construction material. The size of manufactured sand (M-Sand) is under 4.75mm. Because of quickly developing of construction industry, the interest for

manufactured sand has expanded hugely. Because of the exhaustion of good quality river bed sand for the utilization of development, the utilization of manufactured sand has been expanded. Since this sand can be squashed from hard stone rocks, it can be promptly accessible at the near-by place, lessening the cost of transportation from distant river bed sand. The manufactured sand created by legitimate machines can be a superior substitute to river bed sand. The manufactured sand must be of legitimate degree (it ought to have particles from 150 microns to 4.75 mm in appropriate extent). At the point when fine particles are in appropriate extent, the sand will have fewer voids. The cement amount required will be less. Such sand will be more sparing.

2. MATERIAL

2.1: Cement

In this research work Cement used is ordinary Portland cement according to I.S 4031-1988.

S.No	CHARACTERSTICS of Ordinary Portland cement	TEST RESULT	STANDARD RESULT(according to is code)
1	Consistency of cement	31%	30%
2	Initial setting Time of cement	56 min	Not least than 30 min
3	Final setting time of cement	280 min	Not above than 600 min
4	Specific Gravity of cement used	3.154	3.15
5	Fineness Modulus of cement used	5%	Not above than 10%
6	Compressive Strength of cement used	43.5 N/mm2	Not below than 43N/mm2

2.2. Bagasse ash

The Bagasse ash is acquired from the Kisan Sahkari Chini mills limited, Mahmoudabad in Uttar Pradesh. The compressive, flexural strength and split tensile strength increments by expanding the rate of sugarcane bagasse ash. Bagasse is regularly utilized as an essential fuel for sugar factories; when consumed in amount, it produces adequate heat energy to provide every one of the requirements of a normal sugar production process. This material contains an extensive measure of silica which is the sign of cement properties.

-Colour of bagasse ash-Black
-Specific Gravity of bagasse ash-1.8

Table-2

Composition of sugarcane Bagasse Ash		
S.No	Description of properties of bagasse ash	Content Percentage (%)
1	Silica content	71.2
2	Magnesium content	0.68
3	Iron	3.7
4	calcium	9.4
5	Sodium	0.95
6	Alumina	4.56
7	Potassium	2.47

2.3. Manufactured Sand

The M-Sand is a substitute of river bed sand or fine aggregate for construction purposes and manufactured sand delivered from hard rock stone by smashing. The manufactured sand is of cubical shape with grounded edges, washed and reviewed to as a construction material. The size of M-Sand is under 4.7mm. Because of quickly developing of construction industry, the interest for manufactured sand has expanded enormously, bringing about lack of reasonable river bed sand in most piece of the word. Because of the exhaustion of good quality river sand for the utilization of construction, the utilization of manufactured sand has been expanded. The sand must be of legitimate degree (it ought to have particles from 150 microns to 4.75 mm in appropriate extent). At the point when fine particles are in appropriate extent, the sand will have fewer voids. The cement amount required will be less by using manufactured sand. Such manufactured sand will be more efficient and more economical. Interest for manufactured sand is for making concrete is expanding; now a day's river sand can't take care of the rising demand of construction activities.

Table-3

Physical Properties of M-Sand	
Description	Properties of M-Sand
Coarse Sand(size is between 4.75mm to	28.1 % by weight of manufactured sand

2mm)	
Medium Sand((size is between 2mm to 0.425mm)	44.8% by weight of manufactured sand
Fine Sand((size is between 0.425mm to 0.075mm)	27.1% by weight of manufactured sand
Zone of Fine Aggregate (As per IS383)	Zone II
Specific Gravity of M-Sand	2.63
Chemical	Si,Ca,Al,Na,K,Mg,Fe

2.4. Coarse Aggregate

The coarse aggregate were utilized with maximum size of nominal 20mm. The sieve examination of combined and consolidated aggregates affirms to the determinations of IS 383: 1970 for well graded aggregates.

-Specific gravity of coarse aggregate =2.67
-Fineness Modulus of coarse aggregate=6.7

2.5. Water

The Mixing water ought not to contain undesirable natural substances or inorganic constituents in over the top extents. In this research clean consumable water is utilized.

2.6. Mix Design for M25 grade Concrete

The Compressive Strength of M25 concrete required toward the end of 28 days curing: 25 N/mm2

Maximum coarse Aggregate size: nominal 20mm

2.7. Test Data of materials

Specific Gravity of Manufactured sand: 2.63

Specific Gravity of ordinary Portland Cement: 3.157

Specific Gravity of 20mm nominal Coarse Aggregate: 2.70

2.8. Target strength of concrete

For the tolerance factor is 1.65, the acquired target strength for the M-25 grade of concrete = 25 + 4 x 1.65 = 31.6N/mm2

Table-4

The mix design then becomes			
Water	M-Sand	Coarse Aggregate	Cement
186Kg	691.58Kg	1158Kg	380Kg

3. MIXING, CURING AND CASTING OF CONCRETE

3.1 Mixing

The design mix proportioning of concrete was done by the Indian Standard Recommended Method IS 10262:2009. The objective mean strength was 31.6MPa for OPC control concrete, the total cement substance in concrete is 380kg/m3, Manufactured Sand is taken 691.58 kg/m3, coarse aggregate is taken 1158kg/m3 the water-cement proportion was taken consistent 0.47. Hence cement was supplanted by bagasse ash at the different rate of substitution 0%, 5%, 10%, 15%, and 20% by weight of cement.

3.2 Casting

After the concrete was set up than we cast the mould of the cube of size 150mmX150mmX150mm for acquiring the compressive strength of concrete. Before casting the mould the oiling is readied on internal surface of the cube. After Subsequent oiling on the internal surface of the cube than we filled the concrete in the cube and compact that concrete using a tamping rod. The casting of cylinder specimen is same as casting of cube the cylinder is casted for obtaining the split tensile strength of concrete. The diameter of this cylinder specimen is 150mm and length of this cylinder is 300mm. The casting of beam for flexural tensile strength is casted and the size of specimen is 500mmX100mmX100mm. Oil is spread in the inner surface specimen before casting of beam .The entire specimen of cube, cylinder and beam should be cast in three layers and Compact each layer with at the very least 25 strokes for every layer by using tamping rod.

3.3 Curing

After the casting of all specimen then we demould the specimen after 24 hours of casting and then after specimens are cured under water for 7, 14 and 28 days.

3.4 Testing

The compressive strength of any material is characterized as the imperviousness to failure or deflection under the activity of compressive loads. Particularly for concrete, compressive strength is a critical parameter to decide the execution of the material amid service conditions. Concrete mixture can be

composed or proportioned to get the required engineering and sturdiness properties as required.

The compressive strength of any concrete is defined to keep up the coveted quality of concrete at the time of casting. The strength of any concrete is required to ascertain the strength of the individual's members. The specimen of concrete is a casted and tried under the activity of compressive forces to decide the strength of any concrete. In exceptionally basic words, compressive strength is computed by dividing the load at failure of specimen with the area of specimen at which the load is applied. The strength of any concrete is controlled by the ratio of ordinary Portland cement, coarse aggregate and manufactured sand and water. The proportion of the water to cement is the main variable for deciding the concrete strength. The lower the water-cement proportion, the higher is the compressive strength of concrete.

For testing of cube specimens size of cube is 15cm X 15cm X 15cm relying on the extent of the aggregates are utilized. For the vast majority of the works cubical molds of size 15cm x 15cm x 15cm are ordinarily utilized. This concrete is poured in the mould and tempered legitimately so as not to have any voids. Following 24 hours these molds are removed and these specimens are placed in water for curing. The top surface of this specimen ought to be made even and smooth. This is finished by putting concrete glue and spreading easily on the entire area of specimen. These specimens are being tested by compression testing machine following 7 days, 14 days and 28 days curing. Load ought to be gradually applied at the rate of 5 KN/sec till the failure of Specimens.

The split tensile strength is an essential property of concrete since concrete structures are very defenseless against cracking because of different sort of effect and connected load itself. Be that as it may, the tensile strength of concrete is very low in compared with its compressive strength. Because of trouble in applying uniaxial tension to a concrete mould the tensile strength of concrete obtained by indirect test techniques like split tensile strength. It ought to be noticed that split tensile strength test strategy gives the higher estimation of tensile strength than the uniaxial tensile strength.

This test strategy comprises of applying a polar compressive load along the length of entire cylindrical concrete specimen on compression testing machine at a rate of 5KN/Sec that is inside a recommended go until failure happens. This loading generates tensile stresses on the plane containing the connected load and moderately high compressive stresses in the region quickly around the connected load. Tensile failure happens instead of a compressive failure in light of the fact that the regions of load application are in a condition of triaxial compression, in this manner enabling them to withstand substantially higher compressive stresses that would be shown by a uniaxial compressive strength test outcome.

The Flexural strength of concrete is one measure of the tensile strength of concrete. It is a measure of an unreinforced concrete bar or slab to oppose failure of concrete in bending. It is measured by apply load on concrete beams with a traverse length no less than three times the depth. The flexural strength is communicated as Modulus of Rupture. Flexural modulus of a rupture is around 10 to 20 percent of compressive strength relying upon the sort, size and volume of coarse aggregate utilized. In any case, the best relationship for particular materials is gotten by research center tests for given materials and mix design. The modulus of rupture controlled by third-point loading is lower than the modulus of crack dictated by center point loadings, now and again by as much as 15%.

The flexure tensile strength of concrete is conducted on flexural testing machine in which the entire length of the concrete beam specimen is divided in to equally three parts. Then after the two rollers of testing machine which are made of steel applied a point load at the one third distance from both end. So that this loading is called as three point loading. The load applied on this beam with loading rate of this machine is 0.5KN/Sec till the failure of concrete beams specimen.

4. PROPERTIES OF BAGASSE ASH CONCRETE USING M-SAND

Depending upon the property of bagasse ash and manufactured sand the concrete can be made to accomplish the accompanying focal points-

- The rate of silica is high in charge of pozzolanic property in bagasse ash, so that high compressive strength, split tensile strength and flexural tensile strength can be accomplished.
- Silica responds with particles of cement during hydration process imparts extra properties- Chloride resistance, Corrosion resistance and so on.
- Bagasse ash deals in to solve ecological and environmental issue caused by cement generation..
- Bagasse ash enhances the property of cement and it decreases the cost of construction.
- The production of cement is one of the ecological threatening procedures because of the arrival of CO2 and other greenhouse gasses to the environment, yet on account of Bagasse ash, it is eco-friendly as it doesn't deliver CO2 and different risky gasses to the environment.
- Light weight concrete can be made by utilizing bagasse ash because of its low thickness or density.

- Fine particles of manufactured sand are in appropriate extent, the sand will have less voids. The cement amount required will be less. So manufactured sand will be more prudent.
- These physical properties of manufactured sand give more prominent quality to the concrete by diminishing segregation, honeycombing, bleeding and voids.
- The manufactured sand helps the concrete to fill voids between coarse aggregates and makes concrete more compacted and thick, along these lines expanding the strength of concrete.
- M-Sand helps the concrete structures to withstand outrageous natural environmental conditions and keeps the erosion of reinforcement steel by lessening porousness, dampness entrance so that the strength of concrete structures increments.

5. FACTORS AFFECTING STRENGTH OF BAGASSE ASH CONCRETE

- The compressive strength, flexural strength and split tensile strength diminishes if the amount of sugar cane bagasse ash is higher than the quantity required.
- The fineness of bagasse ash is also affecting the strength of concrete.
- Bagasse ash contains high silica and it combines with liberated lime and Lead to excess silica leaching out and it causes deficiency in strength.
- The strength quality of concrete changes when it presented to raised temperature.
- The manufactured sand ought to be in appropriate degree and it ought not to contain pollutions like sediment, silt since it might prompt change the strength quality of concrete.
- On the off chance that the water cement proportion has expanded, the compressive strength of concrete will diminish.
- Any ensnared air is a reason of insufficient compaction of the concrete that will prompt a diminishment in its strength. In the event that there was 10% air in the concrete, the strength of concrete will tumble down in the scope of 30 to 40%.

5. APPLICATION OF BAGASSE ASH CONCRETE WITH M-SAND

In any sugarcane industry every ten tons of sugarcane pulverized, a sugar industry creates around three tons wet bagasse. Bagasse ash is acquired from burning of bagasse in sugar creating industries. Bagasse ash having large amount of silica almost 60% to 80% which has pozzolanic properties. Bagasse ash concrete gives an augmentation in strength of concrete up to 0 to10% substitution of cement with bagasse ash. Sugarcane bagasse ash remains use as cement substitution material to enhance strength and quality of concrete and decrease the cost of concrete structures. The thickness and density of bagasse ash is low so that the lightweight concrete can be made. The cost of the bagasse ash is low and like fly ash. The sugarcane bagasse ash concrete with manufactured sand can be utilized where the light weight concrete is required and where river bed sand is not accessible. The cost of manufactured sand is low when contrasted with river bed sand or coarse sand or fine aggregates. The manufactured sand gives great strength as a compared with river bed sand concrete. So by utilizing bagasse ash and manufactured sand in concrete, the cost of concrete structures and construction will be less and in addition, the strength of the concrete is likewise expanded. Because of quickly developing construction industry, the interest for sand has massively expanded, bringing about an insufficiency of reasonable riverbed sand in most piece of the world. Because of the exhaustion of good quality river bed sand for the utilization of construction, the utilization of manufactured sand has been expanded. Another explanation behind utilizing of M-Sand is its accessibility and low transportation cost that is the reason the cost of manufactured sand is low and construction made sparing. Since this sand can be squashed from hard stone rocks, it can be promptly accessible at the close-by place, decreasing the cost of transportation from far away river bed sand bed. At the point when fine particles are in legitimate extent, the sand will have fewer voids. The cement amount required will be less. Such sand will be more sparing. Interest for manufactured sand for making concrete is expanding now a days as river bed sand can't take care of the rising demand of construction part. Characteristic riverbed sand sand takes a huge number of years to shape and form. Due to its restricted supply, the cost of Natural River sand has soar and its reliable supply can't be ensured. Under these conditions, the utilization of manufactured sand and bagasse ash up to 10% substitution of cement in concrete is sparing and lightweight concrete can be made.

6. COMMITMENT TOWARDS THE SUSTAINABLE DEVELOPMENT

The use of concrete in the world over is second to water. Ordinary Portland cement (OPC) is for the most utilized as an essential cover to made concrete. Due to the popularity of cement, the creation of concrete is going high. Thusly the

creation of carbon dioxide freed to the environment is expanding too. The explanation behind an unnatural weather change is created because of the emanation of greenhouse gasses, for example, carbon dioxide, to the climate by human exercises. So the climate change because of a global warming and ecological protection has turned into a major thing. Concrete creation is not just high vitality concentrated, besides steel and aluminum, additionally, drains the huge measure of the natural resource asset which is a major test for the maintainable sustainable development. Then again, bagasse ash is the waste material of sugar industry. The yield from modern waste materials, for example, Bagasse ash, Fly Ash, Slags, Rice-Husk Ash and so on which can be effortlessly utilized as cement substitution materials. These waste materials make transfer or disposal issue. Hectors of profitable land are required for their transfer or disposal. India creates around 80 million of bagasse as a strong wastage from the sugarcane industrial facility. Transfer or disposal of this strong waste brought out from modern industrial production exercises is an alternate significant issue. For a sustainable improvement, to decrease the utilization of Portland cement in concrete, and utilizing a pozzolanic material, for example, Bagasse ash, fly fiery debris, rice husk powder, silica smolder, ground granulated impact heater slag, and so on as a partial substitute for cement. Manufactured sand is a substitute of a river bed sand for construction and development purposes, manufactured sand created from hard rock stone by pounding. The pulverized manufactured sand is of cubical shape with grounded edges, washed and evaluated to as a construction development material. The extent of manufactured sand (M-Sand) is under 4.75mm. Because of the consumption of good quality river bed sand for the utilization for construction, the utilization of manufactured sand has been expanded. Due to the restricted supply of river bed sand, the cost of Natural River sand has soar and its steady supply can't be ensured. Under these conditions utilization of manufactured sand ends up noticeably inescapable. Use of manufactured sand avoids digging of river beds to get river bed sand which may prompt ecological fiasco like groundwater consumption, water shortage, a danger to the safety of bridges, dams and so on to make M-Sands more eco-accommodating than river sand. The concrete arranged with such industrial wastages and manufactured sand is eco-accommodating. In this way, the bagasse ash concrete by utilizing manufactured sand with lower ecological impression shows considerable guarantee for application in concrete industry. In the terms of a dangerous atmospheric deviation, the bagasse ash concrete could to a great degree lesser the emanation of CO2 to the climate brought on by the cement industries.

The Flexural strength of concrete is one measure of the tensile strength of concrete. It is a measure of an unreinforced concrete bar or slab to oppose failure of concrete in bending. It is measured by apply load on concrete beams with a traverse length no less than three times the depth. The flexural strength is communicated as Modulus of Rupture. Flexural modulus of a rupture is around 10 to 20 percent of compressive strength relying upon the sort, size and volume of coarse aggregate utilized. In any case, the best relationship for particular materials is gotten by research center tests for given materials and mix design. The modulus of rupture controlled by third-point loading is lower than the modulus of crack dictated by center point loadings, now and again by as much as 15%.

7. CONCLUSION

- The compressive strength, split tensile strength and flexural tensile strength increments by expanding rate of Sugarcane bagasse ash up to 10%.
- After 10% replacement of cement the strength of concrete abatements. This is because of amount of sugarcane bagasse ash is higher than the quantity required.
- The Replacement or substitution of cement by sugarcane bagasse ash lessens the industrial waste and to spare the amount of cement required. By sparing the cement it lessened the greenhouse gasses emanation and makes atmosphere green.
- Ordinary Portland cement substitution by sugarcane bagasse ash brings about decrease of creation cost of concrete in scope of 6 to 10%.
- Higher substitution of ordinary Portland cement by sugarcane bagasse ash brought about higher consistency and longer setting time of concrete. The workability of bagasse ash concrete has additionally demonstrated a slight lessening as the sugarcane bagasse ash substance expanded.
- Density and thickness is low so that light weight concrete can be obtained.
- By using bagasse ash and manufactured sand in concrete the construction cost of any structure can be reduced and the structure will be become economical.

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